

shading of the drops forming the fog throughout a considerable distance. Each person looking at his own shadow sees this shading end on, but he can get only a side view of his neighbour's shadow when the fog is near. When the fog-bank is far away compared with the distance between two spectators, each is looking at both shadows practically end on, and both are easily seen.

Edinburgh, February 6.

R. T. OMOND.

#### Corrections in Nomenclature: Ca'ing Whale.

CA'. It's unco silly—the neighbours ca' me a Jacobite = call.

Ca'—And the young lads hae na wit to ca' the cat frae the cream = drive (v. "Encyclop. Dictionary").

J. A. HARVIE BROWN.

#### THE CENTENARY OF KANT.

A HUNDRED years have now passed since the death of Kant. On February 12 the great philosopher died at Königsberg, in East Prussia, where he spent practically his whole life, a long, laborious and ascetic one, in the single-minded and ardent service of science. That his teaching created a remarkable epoch in the history of thought, an epoch, indeed, to which we refer and by which we estimate, of necessity, all subsequent developments, will not be disputed, and so important a centenary has naturally claimed the attention of the whole cultivated world. Immanuel Kant is so much akin to some of our English writers, notably Locke and Hume—was it not Hume who, in his own words, "aroused him from his dogmatic slumbers" and, moreover, does he not himself tell us of his Scottish ancestry?—and in some respects was so much influenced by them, that England may well join with Germany in paying a tribute of reverence to his memory. Kant literature is so voluminous already, and the story of his life, so far as he had a life apart from his work, has been so well told, that little remains to be said beyond a brief reference to his intellectual affinities and to the relationship of his critical philosophy to the existing world of physical science, to compare, in other words, the *a priori* and ideal with the naturalist and *a posteriori* results. An antithesis between these two halves of thought has ever been a prominent feature in our efforts after knowledge, though of late it has grown to be regarded as a convenience in classification rather than an absolute distinction. For many of us the policeman still acts as the representative of ethics, and we are seldom transcendental except in personal instincts. It is also incontestable that

"Until this paragon of spheres  
By philosophic thought coheres,  
The vast machine will be controlled  
By love and hunger as of old."

But in rational development nothing pleads more urgently for reconciliation in the future than these two great currents of human activity, one of which owes so much to the genius of Kant and the other to the indefatigable energy of recent research.

So many and so varied workers have been animated by the spirit of Kant, conscious or unconscious of their debt, that there is a danger of overlooking the strength of his influence. Most can raise the flower now, all have got the seed, and even such dissimilar minds as Hegel, Schopenhauer and von Hartmann are truly consequent on Kant. A whole army is the better equipped for the "celestial panoply" of that solitary epoch-maker, lifted above the merely objective events of his age to his *bestirnte Himmel* by a torrent of thought setting inwards, centripetal rather than centrifugal. So fine a mind, frailly supported by a delicate physique yet disciplined to a rigorous austerity in

matter and spirit, was surely destined to fame. The philosophic habit cannot be put on like a garment. It is all or nothing. To be influenced at all is to be responsive in every fibre; and with Kant the relation of the mind to its world was the San Graal of his quest—his religion. It was for him, too, its own reward, and almost the sole one, though in time he gained more of contemporary fame than comes to some of the great ones of the earth. For, as Spinoza says so deeply, "He who loves God truly must not look to be loved by Him in return."

It is interesting to note that the manner of Kant's intellectual development, as instanced in the chronological record of his works, is from the simpler to the more complex, from the physical to the psychical. It may be pointed out in this connection how solid was the foundation of empirical knowledge upon which he based his epistemology, and this is surely the *sichere Gang der Wissenschaft*. In this long period of apprenticeship we may trace the workings of that marvellous intuitive faculty which he employed in the more abstract realms. His treatises on physical subjects traverse a wide range. In "Thoughts on the True Estimate of *Vis Viva*" he shows the Cartesians and Leibnitzians to be fighting about different things. The dispute was due to incorrectness of definition as to the meaning of force, but it is only fair to say that Kant's views, unknown to him, had been anticipated. In another essay he affirms that the earth's rotation is slowly retarded by the action of the tides. But the "General History and Theory of the Heavens" of 1755 was a more ambitious work. He was then aged thirty-one, and at the height of his speculative power; extending the cosmographical conceptions of Newton to the whole phenomenal cosmos, he introduces for the first time the conceptions of the nebular theory. Though worked out more fully in its details by Laplace at a later date, this soul-stirring thought owes its essential origin to Kant, and may well be associated with his name rather than with that of the great Frenchman. This efflorescence of Kant's comprehensive outlook has been the greatest triumph of cosmography since the publication, some two hundred years earlier, of the "De Revolutionibus Orbium Caelestium." And in his later work Kant was another and no less influential Copernicus who showed how the planet feelings circle round the constructive and illuminating mind, where erstwhile that sun of reason had been held the satellite. He too divined that Nature, in its silent unplumbed depths of space and mind, holds more than earth and man.

The growth of the body of knowledge since the death of that old man in Königsberg may be held to show more of bulk than of differentiation. Yet when we look to the fact that he forged a weapon of research, ready to the hand of all, rather than spend his labour within the meshes of a system such as those woven by Comte and Spencer, we find cause for saying that Chronos does not always devour his own children. We are all thinkers, on our several planes, and the struggle for existence forces us to acute thinking at times, but we commonly fail to shut out the seeming discord between speculative ideals and experience. The pressure of that "unconscious" which according to von Hartmann moulds our lives may seem the agent in advance of materialism, though the moral sphere is not yet wholly at its mercy. The universal practical acquiescence in the dogmas of conduct still silences theoretical doubt. In spite of the gigantic accumulation of scientific facts, no Oedipus has yet returned an answer more permanently satisfying than that which was given by Kant to the central question of the sphinx of life, as to the conditions of all and any

knowledge and of the meaning of personal identity, which must always most strenuously exercise our highest faculties. If there has been any marked shifting of ground, it has been towards the region of personal experience, a return to the principle of *cogito, ergo sum*, a principle of more metaphysical treasure than Descartes himself discovered. The living and dynamic nature of the self has come to stand out in more striking relief. The self-realisation of Hegel and the will of Schopenhauer, ideas so typical of the resolute individual character of western ethics, will illustrate one of the many lines along which Kant's impulse has acted. In nothing is he more emphatic than in urging the necessity of a critical inquiry into the foundations of knowledge before attempting to deal with the opposing dogmatisms of physics and metaphysics, and it is just the validity of his own *Kritik* which has made the later times so productive of reconstructions. The parts in our vast system of knowledge have at the same time become more and more related to an organic whole. More and more has the analogy of the living organism, with its parts in the whole and its whole in the parts, become descriptive of the body corporate of thought, and it may perhaps be said that it enters into our conceptions of the whole of being. Perhaps the full result of this idea in its religious aspect has not yet been realised. Certainly the living purpose of the abstract physical law has not yet been successfully formulated either by transcendentalist or materialist.

ALFRED EARL.

#### THE FORMATION OF CORAL REEFS.

CORAL reefs are divided into three classes, fringing, barrier and atoll. A fringing reef forms a terrace at the low tide level, extending out from the coast of any land, while a barrier reef is a rampart at the same level, lying parallel to the coast, from which it is separated by a deep channel. An atoll is a ring-shaped reef surrounding the lagoon, a basin varying up to 50 fathoms in depth; it is thus in no way connected with any land other than may form upon it.

A typical atoll has a flat encircling reef, generally with a series of islands upon it and a number of channels leading into its lagoon. Where land exists, the reef may be a mile or more broad, but commonly averages about 500 yards. Its surface is a flat of coral limestone almost completely bare of sedentary life. Towards the ocean its edge appears as if the waves were cutting a series of canals into it, but this appearance is really due to buttresses being built out from the rock behind by the reef organisms. Beyond this edge the bottom is extremely rough, but passes gradually into a more even slope. This area, the *reef platform*, may have hollows and pockets filled with debris, but its prevailing characteristic is its almost complete covering of corals, nullipores, Foraminifera, Polyzoa, and other sedentary organisms. At about 250 yards from the edge of the reef, where its depth is about 40 fathoms, it passes somewhat abruptly into a *steep* at a slope often exceeding 50°. This continues to about 140 fathoms, after which the slope, becoming quite moderate, passes gradually into the contour of the surrounding sea. The steep has never been properly investigated, but swabs bring up loose dead masses of such organisms as cover the reef platform above. Their presence is due to the undercurrents resulting from the sea striking on the atoll, which sweep down the reef platform, giving a talus slope (Fig. 3). Again, we have little knowledge of the lower slope down to 500 fathoms, where deep-sea life probably dominates. Shoals at such depths are densely covered with corals, but off atolls the lead only occasionally

brings up a cup. Probably sedentary life is far from scarce, as the fine coral mud, so deleterious to coral life, appears to be swept further out.

Lagoons vary greatly in accordance with their size and depth. A fairly open one has its bottom above the 25 fathom line either bare or covered with coarse sand, but deeper a fine mud may be found. Commonly the depth of any deep lagoon bears some proportion to the depths of the passages into it. Shoals occur anywhere in it, reaching the surface and forming broad flats. From the lagoon floor they arise abruptly, as does also the encircling reef (Fig. 3), a gradual slope to 20 fathoms or less covered with decaying coral masses, and then a perpendicular cliff to the surface.

The examination of the surface of the encircling reef shows it to have been formed by corals, bound together by other organisms. These corals form a definite class not extending below 25 fathoms in any luxuriance. They feed mainly—and many entirely—by their commensal algæ, so that they, as also the nullipores, are dependent for their growth on light and constant change of the water. They are profoundly affected by any deposition of mud, and for this reason upgrowing shoals are rare in lagoons except near passages. The enormous amount of mud formed is shown by its sinking as a deposit around atolls. The muddy water that streams out of the lagoons in stormy weather shows where it originates; but little can come from the surface of the reef, which is stationary in height, and still less from the reef platform, covered as it is by the bodies of living organisms. It is the result of the action of the boring and sand-feeding animals of the lagoons breaking up the coral skeletons and grinding them into the finest mud, much of which passes into suspension in the water. The corals on any low part of the encircling reef over which the lagoon water may pour are killed by this mud, leaving bare areas for the entrance of boring organisms, with the result that a new passage may be cut through the rim into the lagoon. That solution is also of great importance in the lagoons seems certain, for the mud at the bottom of such a lagoon as Suvadiva contains more than 2 per cent. of silica, whereas the sand of the reef has less than 0.04 per cent.

At 40 fathoms different genera of corals, not dependent on commensal algæ, dominate, and at the edge of the reef platform are the builders, their mortar consisting mainly of the encrusting *Polytrema*. They range from the surface, where they are almost choked out by others to 50 fathoms or more, and probably form an important connecting link between the surface builders and the true deep-sea corals, which in the tropics are seldom found above this latter depth. Their rate of growth, and also that of the surface forms, is enormous. Indeed, it would be moderate to estimate that a shoal at 25 fathoms would be built up to the surface in 1000 years, and that one at 50 fathoms would scarcely take more than twice as long.

Recent work has shown that all coral reefs can scarcely be explained on one method of formation. Four modes naturally suggest themselves.<sup>1</sup> (1) (Fig. 1) On any elevation on the bottom of the ocean sedentary animals naturally congregate. Their remains build up its summit to an extent out of all proportion to the upgrowth of the surrounding area, so that it ultimately approaches the surface. The deep-sea corals in warm latitudes give place to their intermediate depth allies, and these again to the reef builders, so that our peak is ultimately crowned with a surface reef. It will be readily understood from the

<sup>1</sup> A fuller consideration of some of the views here put forward will be found in "The Fauna and Geography of the Maldivé and Laccadive Archipelagoes," pp. 12-50, 146-183, 313-346 and 376-423.